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Program 6

Mountain Watching for Landslides Guideline

Proposer: Duong Duc TOAN

- **Objectives:** To understand what kind of danger is lurking in the local area, especially sites that have high landslide susceptibility, what local people should do to prevent landslides, what they should do and where they should evacuate when landslides occur.
- **Target:** Residents, pupils, students, teachers, etc. who are living or going to school in the local area.
- **Type:** Regional/Mountain Watching Guideline

Summary

Mountain Watching is the program that people who are living or going to school in the area, such as residents and pupils etc., walk around, see, and understand different elements in mountains which are linked to disasters and environmental issues.

This guideline was prepared based on Disaster Reduction Hyperbase (DRH) content number 61 and other documents about Regional/Town Watching.

This guideline can be used to organize a regional/mountain watching program over one or two days for local residents in order to help them gain basic knowledge about landslides, how to assess landslide susceptibility, and what they should do to prevent landslides or when landslides occur.

Contents of the guideline as follows:

- Introduction about landslides and Mountain Watching.
- Preparation works for “Mountain Watching for Landslides”: participants, equipment, etc.
- Explanation of “Mountain Watching for Landslides”: purpose, simplified susceptibility assessment of landslides, method of “Mountain Watching for Landslides”.
- Instruction about participants’ activities in the program:
 - Field survey.
 - Developing a map.
 - Problems and solutions discussion.
 - Presentation.
 - Feedback from coordinators.

References

DRH

1. Daniel Jr. Peckley: Rain-induced landslide susceptibility: A guidebook for communities and non-experts, Disaster Reduction Hyperbase (DRH), 2010.
2. Daniel Jr. Peckley, Eduardo T. Bagtang: Rain-induced landslide susceptibility: A guidebook for communities and non-experts, DOST Grant-in-Aid (GIA) Project, 2010.

Others

1. R. Shaw, Y. Takeuchi: Town Watching handbook for disaster education: Enhancing experiential learning, European Union, ISDR, Kyoto University, 2009.
2. R. Shaw, Y. Takeuchi: Sustainable community disaster education in Saijo City and its effectiveness in landslide risk reduction, World Landslide Forum, 2008.
3. Y. Ogawa: Town Watching for disaster prevention guidebook, BOSAI International, 2010.

MOUNTAIN WATCHING FOR LANDSLIDES

GUIDELINE

1. INTRODUCTION

1.1. What is a landslide?

A landslide is a large amount of earth, rock, and other material that moves down a steep slope. Landslides happen when a layer of earth or rocks separates from the layer below it. The force of gravity pulls the loose layer downward.

Landslides can be highly destructive. They can bury or sweep away everything in their path. They can block rivers or cover entire towns.



Figure 1: A landslide [source: *Geology for kids*]

These destructive slides can be triggered by a number of different causes. Often rain, which adds additional weight to the side of a slope, can cause slides. Other times they might be caused by erosion, as the base of a slope is slowly removed by a stream, weakening the entire side of the mountain.

As a slide progresses down a mountain slope, it can pick up tremendous speed, and energy. Some slides have been reported to travel at speeds approaching 300 kilometers per hour. The amount of material moved in a landslide can be tremendous. In some cases this material is so substantial, that it is measured in thousand cubic meters. This much material falling across a stream can be the cause for the formation or a new natural lake.

1.2. What is Mountain Watching?

Mountain Watching is a program that allow people who are living or going to school in the area (such as residents, students, etc.) to walk around, see, and understand different elements in mountains which are linked to disasters and environmental issues.

Mountain Watching consists of the following 5 steps:

➤ *Program explanation:* Coordinators will give the necessary explanations about Mountain Watching, materials, equipment, preparation works, etc.

➤ *Field survey:* Participants will walk around and observe the dangerous places and facilities, and they will also be able to see, hear and record about the facilities, organizations, and solutions to enhance the safety in the local area.

➤ *Develop a map of observation:* Participants will write or draw into the map and make a hand-made local area map for disaster prevention.

➤ *Discuss problems and solutions:* For dangerous places and problems related to disasters which participants learned from the field survey, they will think how those problems can be solved, and draw up a list.

➤ *Presentation:* Each group will present its results to all participants. Presentations will make them realize that what they see is not all, and they will learn from other people's thinking and some points that they missed out. They will understand disaster prevention better by hearing other people's thinking.



Figure 2: An example of Town/Mountain Watching [source: R. Shaw et al.]

2. PREPARATION FOR □MOUNTAIN WATCHING FOR LANDSLIDES□

2.1. Participants:

The participation of various groups is recommended during Mountain Watching: local residents, pupils, students, teachers, etc.

In Mountain Watching, a group that consists of 5 □ 6 persons is recommended. The maximum number is 10 persons in one group. However, if there are many groups, it takes time for the presentation, many coordinators are needed, and many documents, materials and equipment need to be prepared. Therefore, it is generally recommended to form 3 □ 4 groups.

2.2. Necessary items:

➤ Maps:

- Prepare several copies of the map of the area targeted for □Mountain Watching for Landslides□ in A1 and A4 sizes.

- One copy of A1 size map is prepared for each group for developing a map for disaster prevention, draw the observation route, write relevant information into the map, and paste drawing pictures or taken pictures around the map.

- Participants will walk around the inspection area with the A4 map, so this map should be prepared for each participant.

➤ Documents to explain about landslide susceptibility assessment procedure: one handout for each group.

➤ Equipment for landslide susceptibility assessment such as calculators, measuring tapes (5m measuring tapes or longer in length are preferred), angle meter, A4-paper, hammer, 10cm common wire nails, shovel, digging implement, clearing knife: one set for each group.

➤ Cameras (digital cameras or cellphones with digital camera): for taking pictures of places and facilities which are considered dangerous or useful for disaster prevention during field survey. Drawing a picture is an effective method in case digital camera is not available.

➤ Broad-pointed pens, sticky notes, double-stick tape, paper for taking notes, and A1-sized white paper for presentation: one set for each group.

➤ Whiteboard or blackboard: to put maps on during presentation.

➤ Optional equipment (if they are available and participants are familiar with their usage): Video cameras, GPS receiver device, tilt meter, protractor or any device to measure slope angle.

3. EXPLANATION OF □MOUNTAIN WATCHING FOR LANDSLIDES□

3.1. Introduction by coordinators and participants:

In many cases, coordinators and participants meet each other for the first time, so it is an important part of the experience to learn about each other and to create a good atmosphere in which they can have an effective cooperation during Mountain Watching. It also helps coordinators in making groups and deciding the role of each participant in the group.

3.2. Purpose of □Mountain Watching for Landslides□

➤ Coordinators should explain why it is necessary for people who live in the local area to know the risks of a landslide as well as the know-how for landslide protection there. In other words, coordinators explain to the participants to find □good points□and □bad points□against a landslide.

➤ It is a basic that people have to protect themselves. When they are in danger, they can avoid danger by judging from various situations around and taking appropriate actions. Therefore, it is necessary to understand what kind of danger is lurking in the local area, what people should do, and where they should evacuate when a landslide occurs. In order to decrease danger in the region, people have to make their area better by themselves, without expecting outside help.

➤ □Mountain Watching for Landslides□also allows that participants to reflect on how they can solve the problems found in the local area by field survey. Participants can implement some solutions by themselves or involving associations in the local area.

3.3. Explanation of □Simplified susceptibility assessment of landslides□

➤ A simplified susceptibility assessment of landslides will be explained to participants based on Disaster Reduction Hyperbase (DRH) content number 61 , entitled □Rain-induced landslide susceptibility: A guidebook for communities and non-experts□

➤ This DRH content developed a simple, graphical and site-specific assessment procedure that can enable communities and non-experts to assess the rain-induced landslide susceptibility of their areas on their own.

➤ The assessment procedure takes off from the idea that the strength of the material or structure S should always be greater than the applied load or force L ($S > L$). This concept could be expressed as a factor commonly referred in engineering as Factor of Safety $F_s = S/L$, which should always be greater than 1, as show in Figure 3.

In this landslide susceptibility assessment procedure, the S/L ratio is referred to as the Factor of Stability and its basic definition is $F_{sbasic} = \frac{SRating}{\alpha Rating}$, where $SRating$ is the strength rating or score of the slope material and $\alpha Rating$ is the rating for the slope angle α . The main landslide driving force is gravity and it is directly related to the slope angle α ; the higher the

slope angle α , the higher the α Rating. Basic Factor of Safety for slopes ($F_{s_{basic}}$) is illustrated in Figure 4.

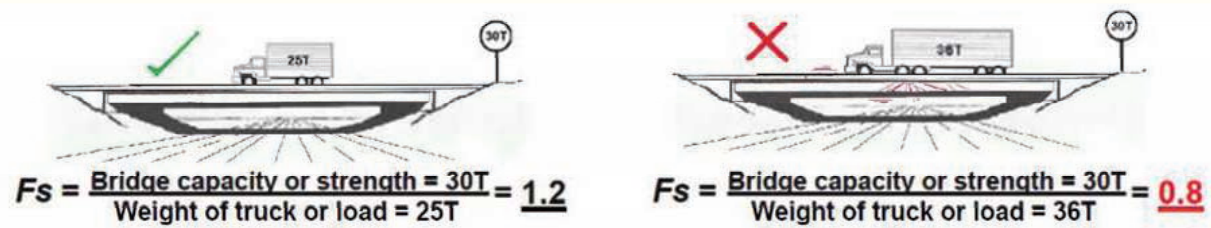


Figure 3: Factor of safety (F_s) for a 30-ton-capacity bridge [source: DRH 61]

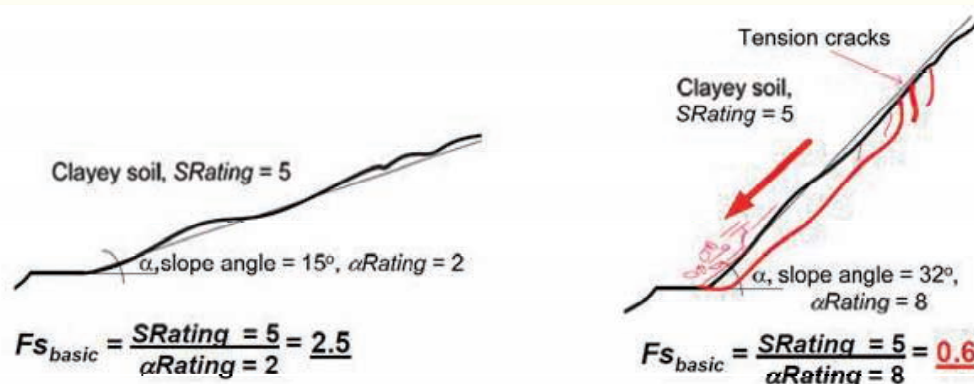


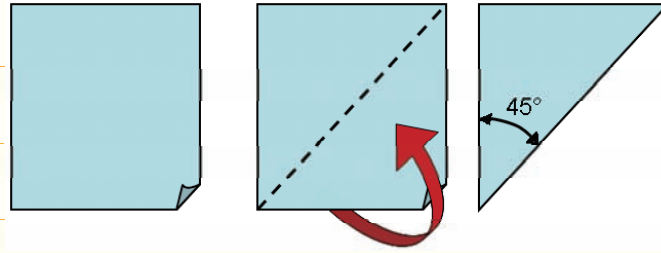
Figure 4: Basic Factor of Stability for slopes, $F_{s_{basic}}$ [source: DRH 61]

The following parts will explain how to define SRating and α Rating.

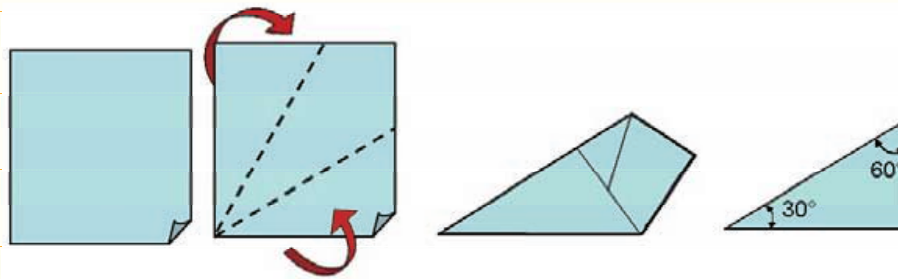
➤ Measuring slope angle using angle meter or paper:

Without angle meter or tilt meter, α can be approximated using the following folded paper technique:

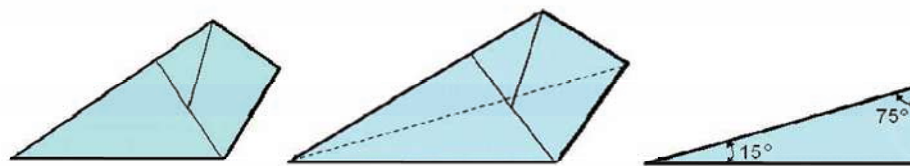
- To form a 45° angle, fold a square-shaped piece of paper into half, diagonally, forming two triangles of equal size.



- To form a 30° and 60° angle, fold the square paper as shown below, with the corner angle divided into three equal parts. The corner with the smallest angle is the 30° while the next larger corner is the 60°



- To form the 15° and 75° angle, make a same shape as in previous part, fold the smaller angle (30°) one more time, into half. The smallest angle produced is the 15° while the next larger angle is the 75°



- To estimate the slope angle using this technique, find a spot outside the area being investigated where a side-view of the slope can be spotted and the slope angle can be visually compared with any of the above paper-fold angles (see Figure 5).

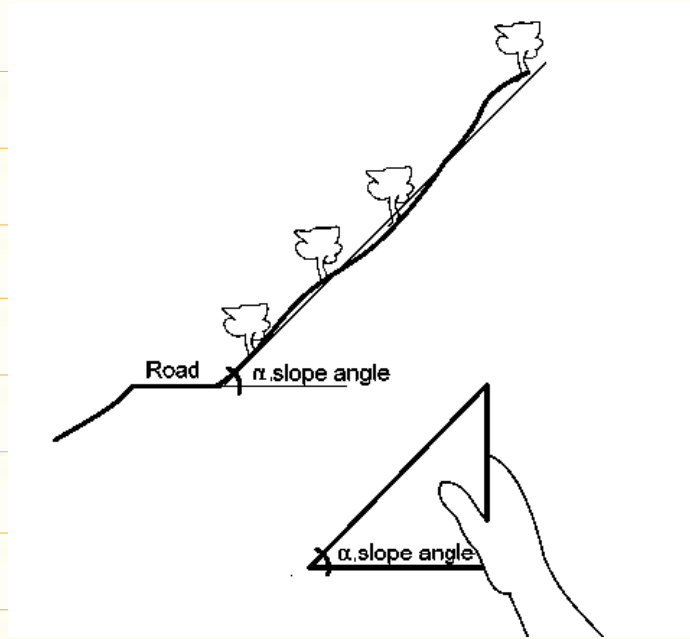


Figure 5: Comparing a folded-paper angle with the slope angle α

➤ α Rating and SRating:

Table 1 and Table 2 show values of strength rating or score of the slope material SRating and slope rating α Rating corresponding to slope angle and slope material.

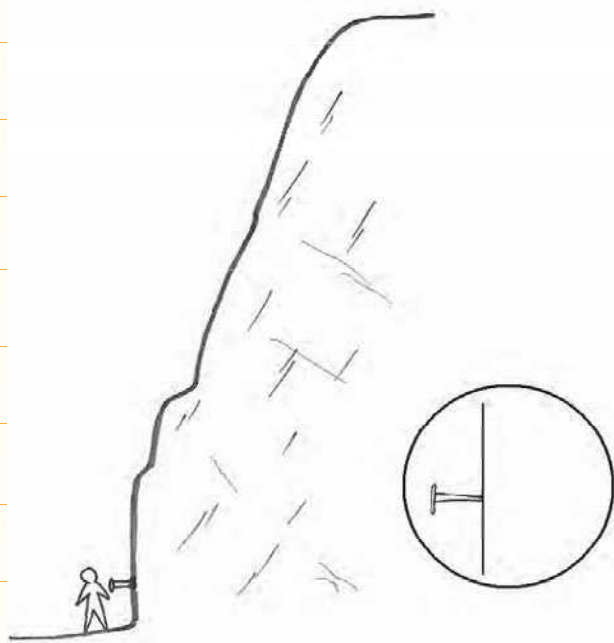
Table 1: Ranges of slope angle α and corresponding α Rating [source: DRH 61]

Slope angle α	α Rating
α greater than 75° ($\alpha > 75^\circ$)	100
α greater than 60° but less than or equal to 75° ($60^\circ < \alpha \leq 75^\circ$)	32
α greater than 45° but less than or equal to 60° ($45^\circ < \alpha \leq 60^\circ$)	17
α greater than 30° but less than or equal to 45° ($30^\circ < \alpha \leq 45^\circ$)	10
α greater than 15° but less than or equal to 30° ($15^\circ < \alpha \leq 30^\circ$)	5
α less than or equal to 15° ($\alpha \leq 15^\circ$)	2

Table 2: *Slope material and SRating [source: DRH 61]*

Material ID	Slope material	SRating	Reference figures and photographs
HR1	Massive and intact hard rock	100	Figure 6-1, 6-2
HR2	Blocky, well-interlocked hard rock, rock mass consisting mostly of cubical blocks	45	Figure 7-1, 7-2
HR3	Very blocky and fractured hard rock (disturbed with multifaceted angular blocks formed by 4 or more discontinuity sets)	25	Figure 8-1, 8-2
HR4	Disintegrated, unstable rocks and boulders, protruding rock fragments	13	Figure 9-1, 9-2
SR1	Massive and intact soft rock	30	Figure 10-1, 10-2
SR2	Very blocky and fractured soft rock	15	Figure 11-1, 11-2
HS1	Stiff, cemented and dense gravelly, sandy, silty and clayey soils	25	Figure 12-1, 12-2
SS1	Gravelly soil	10	Figure 13-1, 13-2
SS2	Sandy soil	8	Figure 14-1, 15-2
SS3	Clayey/silty soil	5	Figure 15-1, 15-2

For each of the slope materials listed above, reference figures and sample photographs are provided in the next part, from Figure 6-1 to Figure 15-2, as guides in identifying the classification of slope material.



- a) Hard rock □ cannot be penetrated by 10cm common wire nail with a hammer
- b) Massive and intact □ few widely spaced cracks or discontinuities, equal or greater than 2m apart, no predominant discontinuity

Figure 6-1: *HR1 - Massive and intact hard rock [source: DRH 61]*



Figure 6-2: Sample photos of massive and intact hard rock [source: DRH 61]

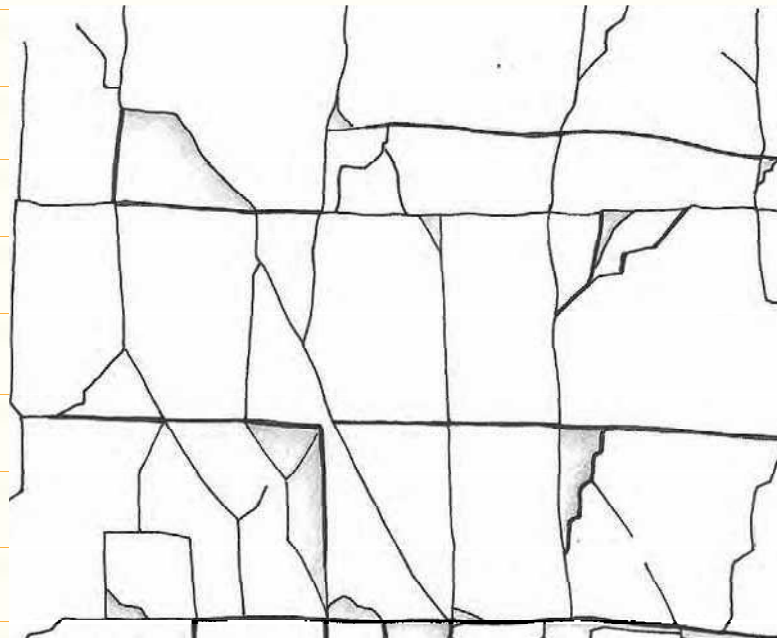


Figure 7-1: HR2 - Blocky, well-interlocked hard rock [source: DRH 61]

- a) Hard rock ☐ cannot be penetrated by 10cm common wire nail with a hammer
- b) Size of blocks mostly between 60cm and 2m

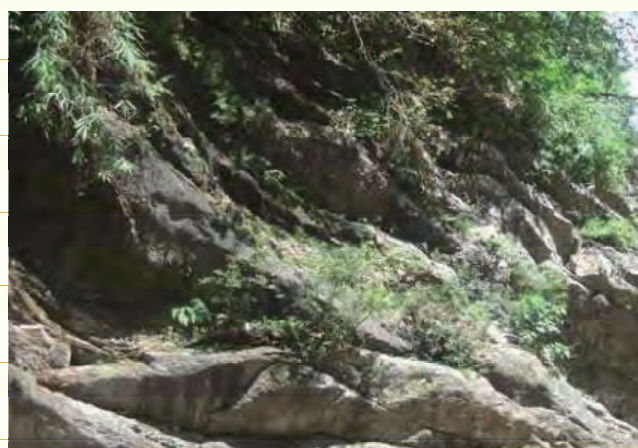
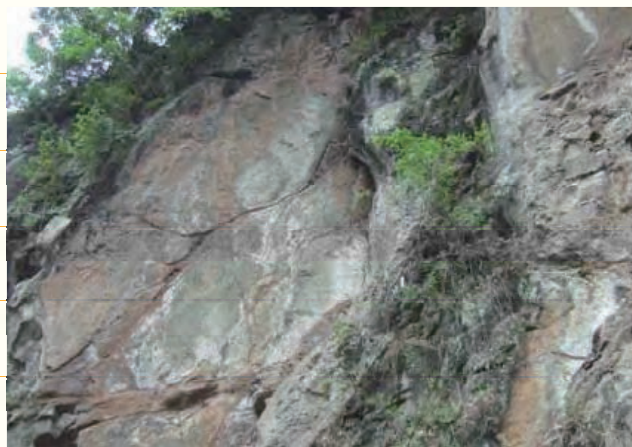


Figure 7-2: Sample photos of blocky, well-interlocked hard rock [source: DRH 61]

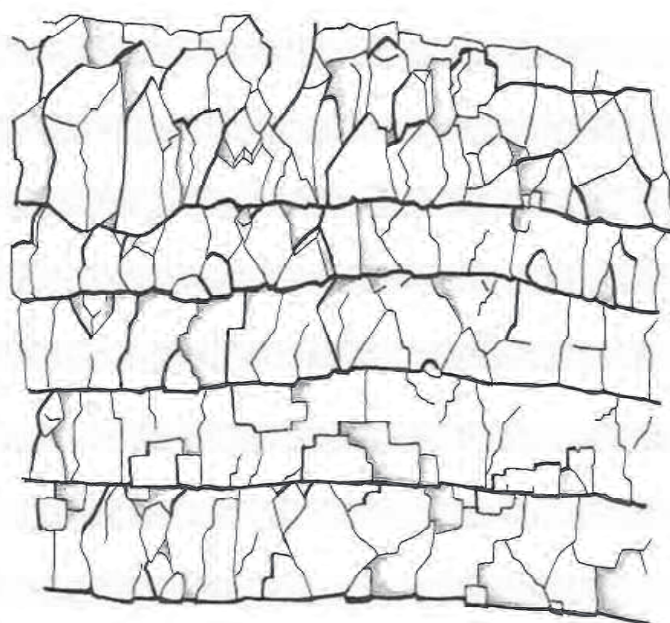


Figure 8-1: HR3 - Very blocky, fractured and disturbed hard rock [source: DRH 61]

- a) Hard rock ☐ cannot be penetrated by 10cm common wire nail with a hammer
- b) Size of blocks mostly between 10cm and 60cm



Figure 8-2: *Samples of very blocky, fractured and disturbed hard rock [source: DRH 61]*

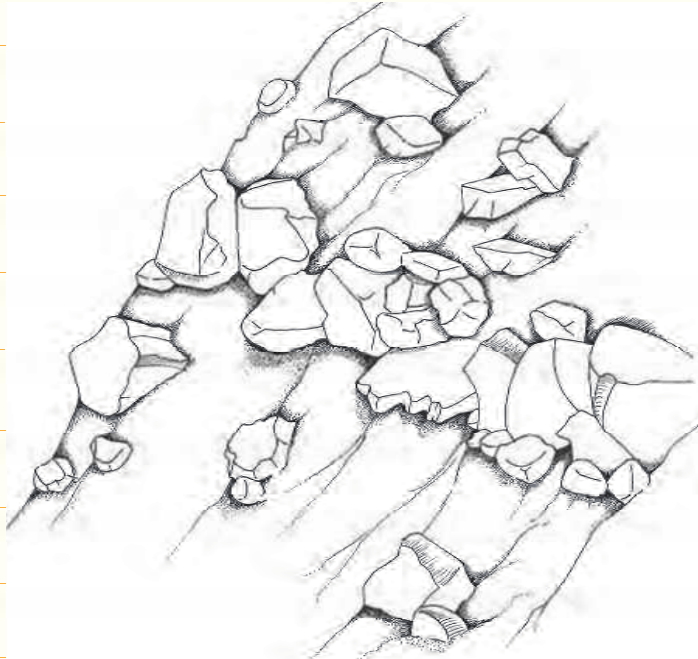
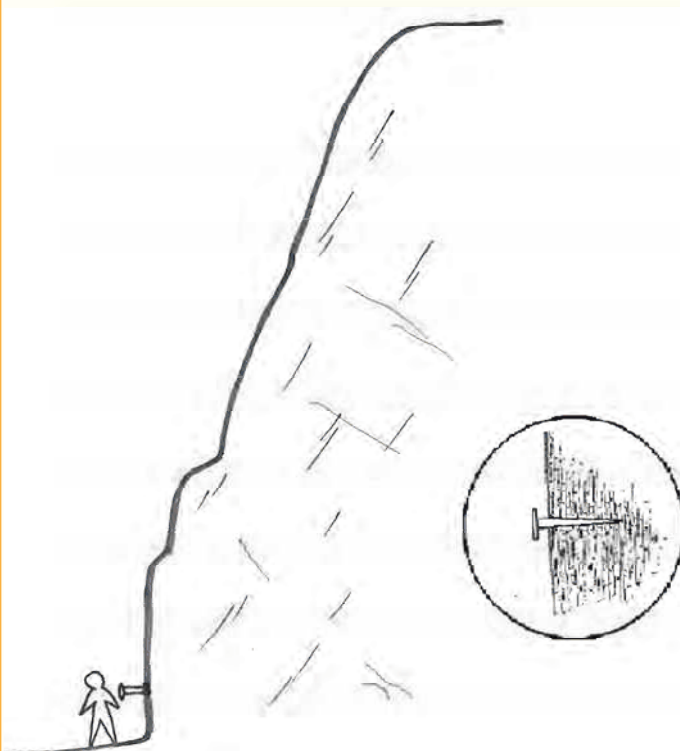


Figure 9-1: *HR4- Disintegrated, unstable and protruding rocks [source: DRH 61]*
a) May include soft rock fragments b) Size of blocks varies



Figure 9-2: *Samples of disintegrated, unstable and protruding rocks [source: DRH 61]*



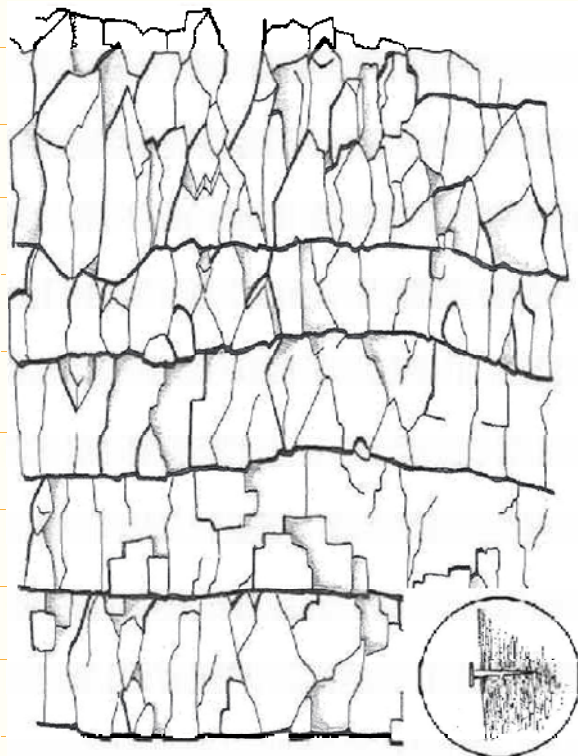
a) Soft rock □ can be penetrated by a 10cm common wire nail with hammer; weaker than concrete but a fist-sized sample will not crumble or deform with hand pressure

b) Massive and intact - few widely spaced cracks or discontinuities, equal or greater than 2m apart, no predominant discontinuity

Figure 10-1: *SR1 - Massive and intact soft rock [source: DRH 61]*



Figure 10-2: *Sample photos of massive and intact soft rock [source: DRH 61]*



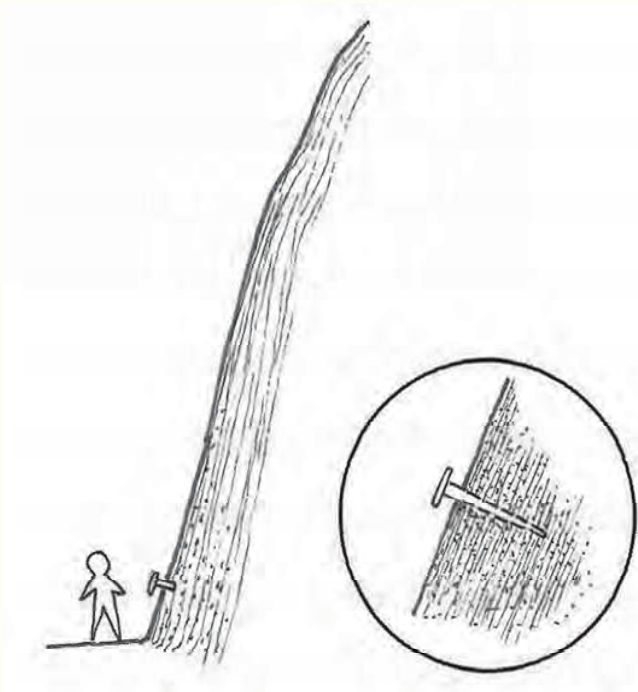
a) Soft rock □ can be penetrated by a 10cm common wire nail with hammer; weaker than concrete but will not crumble or deform with hand pressure

b) Size of blocks mostly between 10cm and 60cm

Figure 11-1: *SR2 - Very blocky and fractured soft rock [source: DRH 61]*



Figure 11-2: Sample photos of very blocky and fractured soft rock [source: DRH 61]



Stiff soil

- can be penetrated by a 10cm common wire nail with hammer
- a fist-sized sample will crumble or deform with hand pressure but will not crumble or deform with finger pressure
- thumb will not indent soil but readily indented with thumbnail

Figure 12-1: HS1 - Stiff, cemented and dense gravelly, sandy, silty and clayey soils [source: DRH 61]



Figure 12-2: Sample photos of stiff, cemented and dense gravelly, sandy, silty and clayey soils
[source: DRH 61]

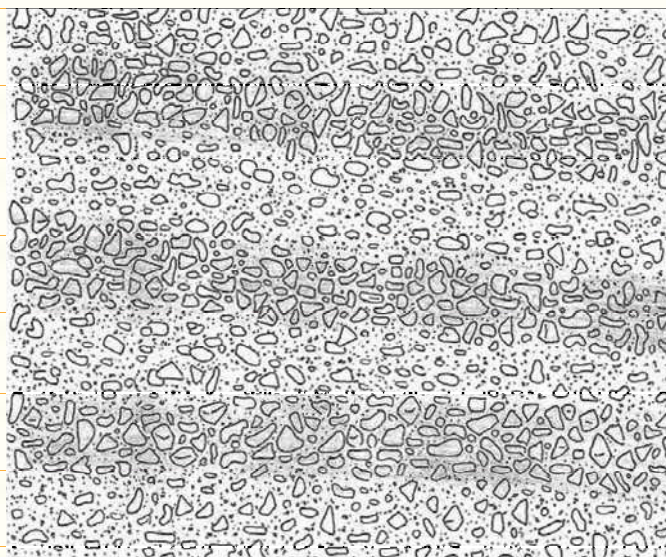


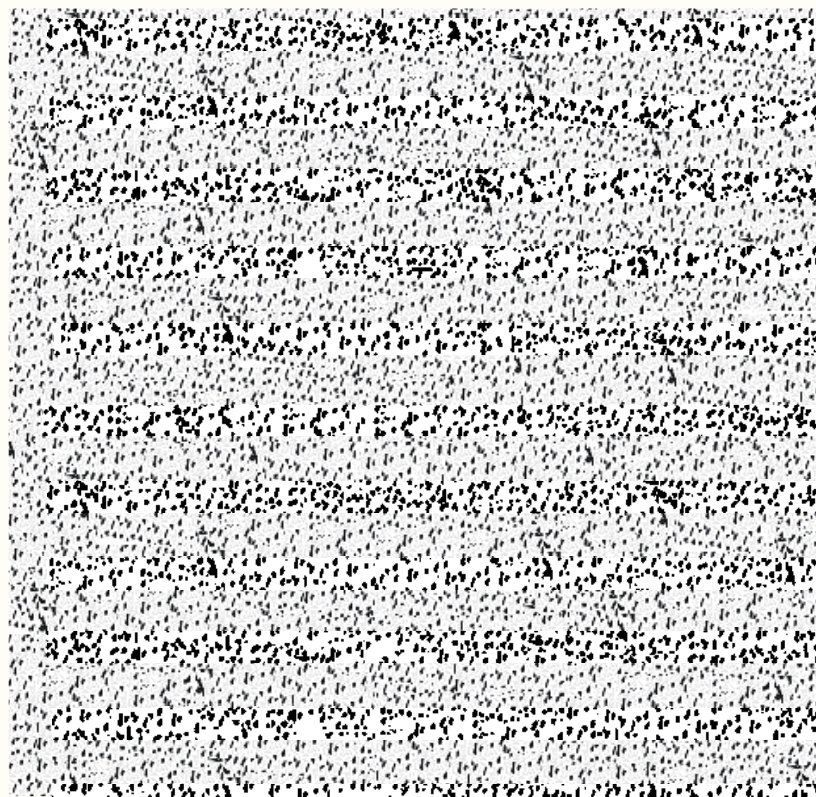
Figure 13-1: SS1 - Gravelly soil [2]

Gravelly soil:

- Size of most particles between 5mm to 75mm
- Fist-sized sample or smaller, containing 5 or more particles, will crumble with finger pressure



Figure 13-2: *Sample photos of gravelly soil [source: DRH 61]*



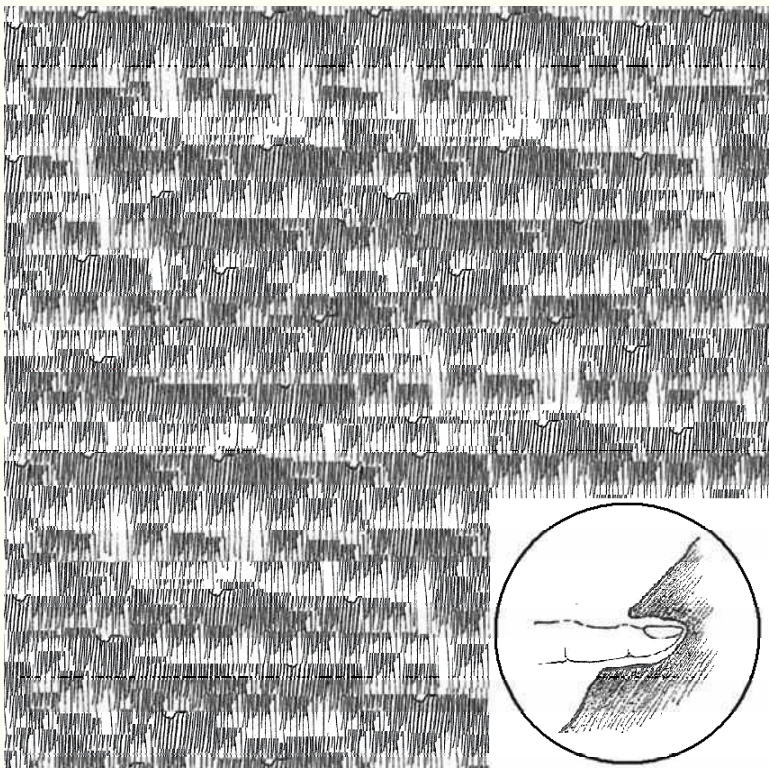
Sandy soil

- *size of most particles finer than 5mm and grains can be distinctly felt with fingers*
- *sample will crumble with finger pressure*

Figure 14-1: *SS2 □ Sandy soil [source: DRH 61]*



Figure 14-2: Sample photos of sandy soil [source: DRH 61]



Clayey, silty soil

- particles cannot be felt with fingers, especially when wet, soap like
- can be indented with thumb and will crumble with finger pressure

Figure 15-1: SS3 □ Clayey/silty soil [source: DRH 61]



Figure 15-2: Sample photos of clayey/silty soil [source: DRH 61]

➤ *For non-uniform slope angle and slope material sites:*

- If the slope angle varies, but the variation is within a range of angles defined in Table 1, and if the predominant material is practically uniform around the area, then this area can already be identified as one site.

- If the slope angle varies and the variation is not within a range of angles defined in Table 1 or if the slope material is not uniform around the area of interest, then subdivide the area into sub-areas with widths of around 10m or even longer. Determine the Fs for each sub-area. Figure 16 illustrates how this is done.

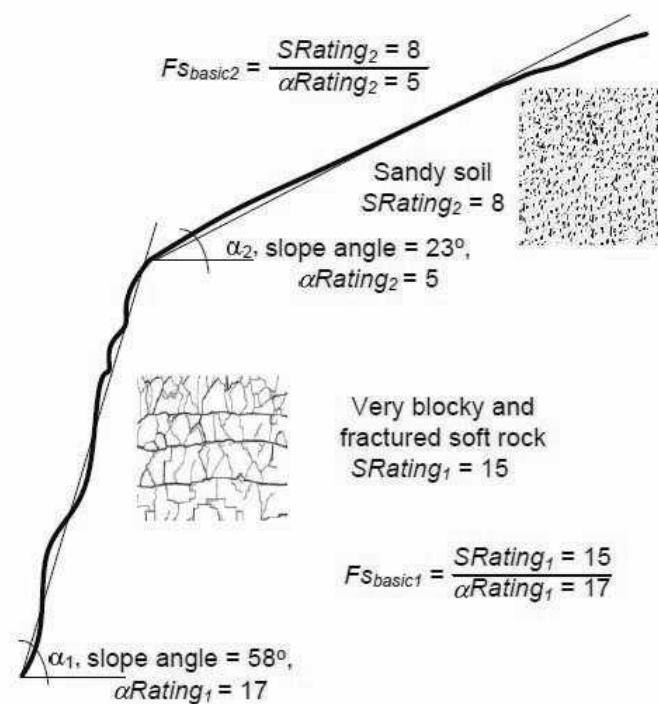


Figure 16: Slope with varying slope angle and different slope material [source: DRH 61]

➤ For slope covered by vegetation:

If the predominant slope material cannot be identified or ascertained because the slope is covered with vegetation, do the following:

- Select and clear at least three slope material sampling points, with area of each sampling point around 1 square meter as shown in Figure 17 and 18.

- After clearing, if the predominant slope material is rock, use the reference figures and photographs listed above to classify the rock material. If slope material is soil, dig at the sampling points to a depth of at least around 0.5m. Use the reference figures and photographs listed above to classify the soil material.

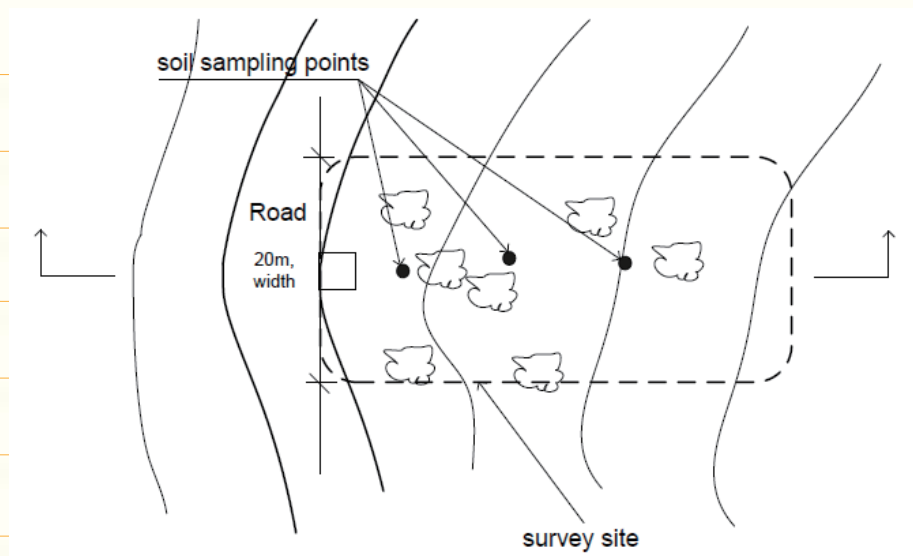


Figure 17: Site plan-view or top-view [source: DRH 61]

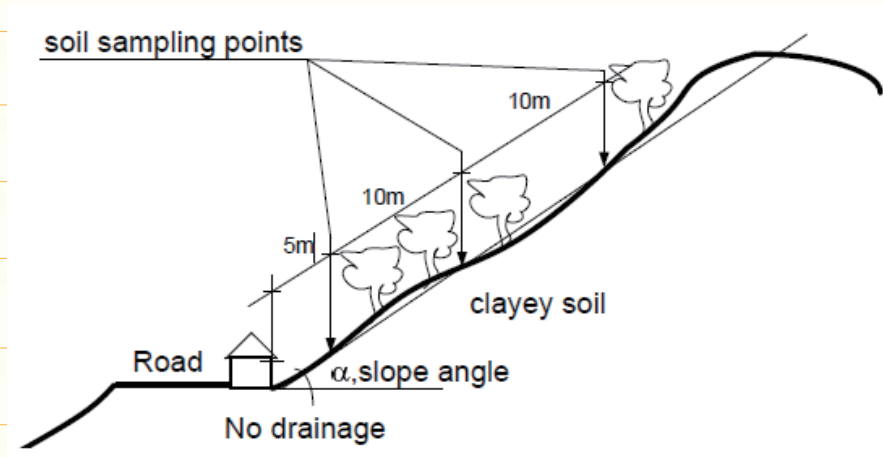


Figure 18: Site cross-section or side-view [source: DRH 61]

➤ When other factors affecting landslide susceptibility such as vegetation cover, land use, etc. are considered, F_s can be expressed as:

$$F_s = vFactor * fFactor * (S_{Rating} - s_{Red} - d_{Red})_{Rating} * lFactor$$

Here, the $vFactor$ represents the effect of vegetation cover of the slope on the Factor of Stability. The $fFactor$ takes into account the frequency of slope failure, presence of cracks and previous failure history. s_{Red} takes into account the reduction of the shear strength of the slope material due to saturation as indicated by the presence of spring or the elevation of groundwater table due to rainfall infiltration. The d_{Red} factor represents another reduction of shear strength of the material due to saturation due to poor drainage system. The $lFactor$ is a factor that takes into account the existing land use.

➤ Vegetation cover factor: vFactor

Table 3: *Types of vegetation and numerical values for vFactor [source: DRH 61]*

Type of vegetation	vFactor
No vegetation	1.0
Predominantly grass or vegetation with shallow roots	1.1
Coconut, bamboo or vegetation with moderately deep roots	1.2
Dense forests with same specie trees having age less than or equal to 20 years	1.5
Dense and mixed forests with trees having age less than or equal to 20 years	2.0
Dense forests with pine trees having ages of more than 20 years	2.0
Dense and mixed forests with trees having ages of more than 20 years	2.5

** Unless you are certain that the trees on your slope are more than 20 year old, use of a vFactor = 1.5 would be more prudent.*

➤ Frequency of failure, deformation (e.g. rock fall, slides) factor: fFactor

Table 4: *Frequency/occurrence of failure and numerical values for fFactor [source: DRH 61]*

Frequency/occurrence of failure	fFactor
Once a year or more than once a year	0.5
Presence of past failure, but occurrence not yearly	0.7
Presence of tensile cracks in ground	0.7
If with retaining wall, wall is deformed	0.7
None	1.2

** If participants are unfamiliar with the place, conversations with the residents of the area can provide useful information on failures that may have occurred in the past.*

➤ Presence of spring factor: sRed

Table 5: *Presence of spring and numerical values of sRed [source: DRH 61]*

Duration	sRed
Yearlong	2
Only during rainy season	1
No flow/spring	0

➤ Condition of drainage/canal/culvert factor (with the site/slope): dRed

Table 6: Drainage condition and numerical values for dRed [source: DRH 61]

Drainage condition	dRed
No drainage system	2
Totally clogged, filled with debris	2
Partially clogged or overflows during heavy rains	1
Water leaks into the slope	1
Good working condition	0

➤ Land use factor (within the site/slope): lFactor

Table 7: Land use and numerical values for lFactor [source: DRH 61]

Land use	lFactor
Dense residential area (with closely spaced structures <5m)	1.4
Commercial with buildings having 2 storeys or more	1.4
Residential area with buildings having 2 storeys spaced at ≥5m	1.25
Road/highway with heavy traffic (1 truck or more every 10mins)	1.4
Road/highway with light traffic (less than 1 truck every 10mins)	1.25
Agricultural area, grasslands and bush lands	1.0
Forest	1.0
Uninhabited and no vegetation	1.0

➤ Amount of rainfall (mm) in 24 hours: Rain

When rainfall data are available or rainfall being measured, the sRed and dRed factors can be replaced by a single factor called Rain. And Fs becomes

$$F_s = vFactor * fFactor * (SRating - Rain)Rating * lFactor$$

Table 8: Amount of rainfall (mm) in 24 hours [source: DRH 61]

Amount of rainfall (mm) in 24 hours	Rain
50mm or less	0
More than 50mm but less than 100mm	2
More than 100mm but less than 200mm	3
More than 200mm	4

➤ Landslide susceptibility:

Table 9: *Landslide susceptibility [source: DRH 61]*

Landslide susceptibility	Fs
Stable	$F_s \geq 1.2$
Marginally stable	$1.0 \leq F_s < 1.2$
Susceptible	$0.7 \leq F_s < 1.0$
Highly susceptible	$F_s < 0.7$

If the F_s is less than 1 and if life, limb and property are at stake:

- Evacuate whenever a strong rain (due to a typhoon) is forecasted/expected to fall in the area.
- Report the situation immediately to concerned authorities with a request for more detailed evaluation to be carried out by a geotechnical engineer or engineering geologist.
- If the affected area is a private property, the owner should take the initiative to consult a geotechnical engineer or an engineering geologist for appropriate mitigation measures.

Even if the slope has been found to be marginally stable ($1.0 \leq F_s < 1.2$), if a failure would affect several households or a community, a more detailed geotechnical site assessment should be carried out.

3.4. Explanation the method of □Mountain Watching for Landslides□:

- Coordinators explain about field survey, developing a map, discussing solutions, and making a presentation.
- The places for field survey will be explained by showing the prepared map.
- Decide on a starting point, a goal point, starting time, and closing time.
- Divide participants into several groups. Target areas for field survey are also divided when making groups. Participants are grouped based on their residential area. It makes it easier to decide on a target region, because they are familiar with the area and may uncover new findings and provide new insights.
- In view of the total number of participants, each group should consist of 5-6 persons. As for forming groups, in view of age, section, etc., it is better that they should be arranged in advance and have various people in one group.
- Determine the role of each person in a group: 1 person for the group leader, 1 person for taking pictures, recording the location of taking pictures and the reason for taking pictures, 1 person for measuring slope angle, 1 person for identifying slope material and other people focus on observation other factors.

➤ Explain the tools and equipment for field survey: map; camera; angle meter, tilt meter or paper for measuring slope angle; hammer and 10cm common wire nails for identifying slope material, calculator for calculating Fs, paper for taking notes, etc.

➤ Explain precautions during field survey. Participants have to be careful about traffic, rock fall, sliding on slope, actions against hot or cold weather, rain, etc.

4. FIELD SURVEY

➤ Go to the starting point of the observation route.

➤ Start by each group and observe the local area.

➤ It is recommended that one coordinator be assigned to each group. However, the coordinator should not give advice to participants. If the observation point is rough and participants have difficulty in measuring angle slope, identifying slope material or other factors, or if they cannot identify the different problems, the coordinator should then guide them on where to direct their attention and solve the problems. If the group takes too much time in its observations, the coordinator can speed the operations up in order to go back to the meeting point in time.

➤ Participants can observe by walking, find out sites in danger of a landslide in the local area, the houses that may be affected by landslides. They can also measure the Factor of Stability in those observation sites. Participants also see, hear about and record the facilities provided against danger as road or field for evacuation, organization for disaster prevention by residents, and the existing solutions in the local area such as an evacuation drill, etc.

➤ It is important to interview the local residents in order to know the area well. Even if participants reside in the local area, they may not know about past disasters because not all residents participate in this program. Thus, it is important to get a lot of information by interviewing people in the area when participants walk around and meet them.

5. DEVELOPING A MAP

➤ After finishing the field survey, all participants gather in a classroom or conference room and start developing a map.

➤ The aim of developing a map is to make a hand-made local hazard map for landslide by writing down the observations made by the participants during the field survey.



Figure 19: Examples of Town/Mountain Watching map [sourc; Y. Ogawa]

- It is difficult for participants who join this activity for the first time to imagine the completed map for disaster prevention, so it would be better for them to start drawing the route onto a large map as they walk.
- Indicate the location where they took pictures or draw pictures on the map. At the same time, check whether those pictures or drawings are good points or bad points. If they are bad, put a red circle, and if they are good, put a green/blue circle on the edge of the picture. Write a few simple explanations in the margin next to the picture.
- Paste pictures around a large map, and connect the pictures and location where they were taken with a line, so that participants can see where they walked and what kind of pictures they took. The map, which shows red circles for bad points and green/blue circles for good points, is easy to understand.

6. PROBLEMS AND SOLUTIONS DISCUSSION

- Each group makes a list of problems related to landslides that they learned through the field survey.
- In the group, discuss ideas about how to solve problems and draw a list. Try to find as many solutions as possible.
- Discuss about the main person/organization to work on solving the problems and show below list for reference: individual or family, community in the local area, local government such as municipal office, rules and regulations, etc.
- Many solutions can be found in cooperation with different organizations and a scheme for aid by public offices is necessary. In that case, participants need to think about organization to support main person/organization and cooperators.
- Discuss how long it should take to solve the problem.

- Write down solutions on A0-size paper for presentation.

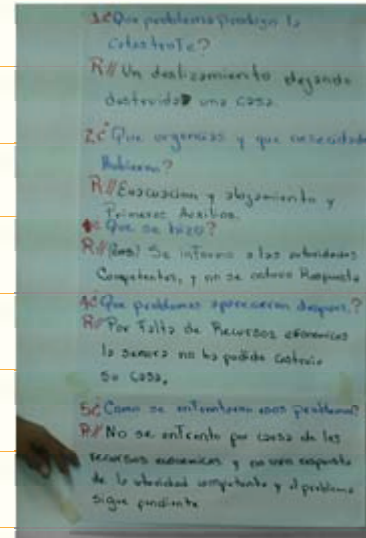


Figure 20: Solutions discussion [source: Y. Ogawa]

7. PRESENTATION

Each group makes a presentation to all participants about their results. Presentations make participants realize that what they see is not all, and they will learn other people's thinking and some points that they missed out. By putting together other people's results, the local hazard map for landslides will be improved.



Figure 21: A Town/Mountain Watching presentation [source: Y. Ogawa]

8. FEEDBACK BY COORDINATORS

- Mountain Watching does not require the quality of completed map or the validity of solutions. The purpose of this program is to find dangerous points (bad points) through field survey by ourselves and recognize the points that contribute to reduce the danger (good points).
- Participants see the local area where they live from the viewpoint of observing good points and bad points regarding disaster, they realize that will they know various things indeed. And it is useful for communities to improve awareness of disaster prevention.
- It is not desirable to evaluate the completeness of the map. It is more important to recognize many problems and come up with many solutions against them.
- People cannot reduce the dangers lurking in local areas without solving problems, and if they wait for someone's help without doing anything by themselves, they put themselves and their family at risk.

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